The Imperial Institute.

It is astonishing that, at a time when the Imperial Institute is looking forward to further developments in its work, a proposal should be put forward involving the dismantling of more than half of the recently extended and improved collections in the Public Exhibition Galleries of the Institute—without question the finest illustration of economic geography in the world—in order to make room for the war relics known as the Imperial War Museum at present housed in the Crystal Palace. The *Times* of March 7 contains leading and special articles on the subject in which a clear case is made for the abandonment of the proposal. Attention is directed to the resolution of protest recently passed by the Executive Council of the Institute. While appreciating the desire for economy in housing the War Museum, the council considers that this object should be achieved by some other method than by a plan which would be seriously detrimental to the development of the educational and commercial work for which the Imperial Institute was erected and endowed. Resolutions of protest have also been received by the council from a number of important bodies, including the Association of British Chambers of Commerce; the Chambers of Commerce of Liverpool, Manchester, Glasgow, and Bristol; the Royal Institute of British Architects; the Timber Trade Federation; the Institute of Builders; and the Silk Association.

For a quarter of a century the Imperial Institute with very slender means has been carrying on work of great service to the Empire, a fact far too little known and appreciated. The reward of such endeavour should be the provision of better facilities for development, and it is precisely in this respect that the proposals now put forward on behalf of the War Museum would be so detrimental in their effects. The Imperial Institute is becoming the recognised headquarters of organised effort in this country for the development of knowledge of the natural resources of the overseas countries of the Empire, and it is to be hoped that the Government will see that nothing of the character of the proposals justly condemned by the *Times* shall prevent the achievement of so desirable a purpose.

A Treatise on Petroleum.

Petroleum. By Sir Boverton Redwood. Fourth edition, reset throughout. In three Volumes: Vol. 1, pp. xxx+364+pl. 16. Vol. 2, pp. iv+365-740+pl. 17-31. Vol. 3, pp. iv+741-1353. (London: C. Griffin & Co., Ltd., 1922.) £5, 5*s*. net.

In a review of the first edition of this work, published in NATURE in December 1896 (vol. 55, p. 169), it was asserted that "to write, or to compile a comprehensive text-book on petroleum, demands an acquaintance with dissimilar subjects and varying walks of life, very rarely centred in one individual. The present work is and will ever remain remarkable as the production of a man whose scientific attainments, and whose relation to the petroleum industries, were such that he, probably better than any other living man, was fitted to undertake the task."

During the quarter of a century that has since elapsed the "dissimilar" sciences that form the foundation of petroleum technology have both widened and deepened; chemical research has extended our knowledge of the constitution of the hydrocarbons that form mineral oil; the newly developed branch of colloidal chemistry, in its bearing on the properties of argillaceous substances, has affected the methods of refining and thrown new light on the problems of crude-oil migration underground; the discovery of new occurrences and, especially, the compilation of data obtained from established fields have put a new complexion on the questions of oil geology; improvements in mechanical engineering have modified the methods of exploitation and transport; whilst the remarkable development in the use of internal combustion engines, inspired by stern necessity during the war, has been accompanied by an extension of the theoretical and practical aspects of oil as a source of power. In complexity and volume each of these phases of the natural history of oil and the technique of its uses is to-day comparable to the whole range of petroleum technology as it was when Sir Boverton Redwood first attempted the task of summarising the disconnected and apparently unrelated data of the petroleum industry.

To keep in touch with these developments was perhaps possible to the author if to no one else; to keep abreast of them he frankly recognised as impossible, and thus we find in this new edition of a work which "is and will ever remain remarkable" the results of the friendly co-operation of more than two dozen specialists. The contributory work of these friends is evidence of their belief in the value of this treatise as a work of reference, and is at the same time a sign of the magnetic personality of the author and the affectionate respect with which he was regarded among all classes of workers in the oil world. But the thorough revision of some parts in this way serves to bring into relief others which remain as they were issued with the third edition in 1913. The book in this respect bears the marks of the war, during which the author's unremitting devotion to honorary public service left him insufficient time for his accustomed methodical compilation of new facts and for the judicial examination of new theories. To specialists in the accessory sciences and to local workers in distant fields, who will necessarily subject appropriate

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chapters to microscopic analysis, the deficiencies thus left will be obvious; to those who knew the author personally, and were thus able to estimate the heavy burdens which were laid on him during the anxious years 1914–18, these blemishes will be regarded as veritable war wounds.

Thus, this fourth edition of a recognised standard work, even with its blemishes, will be to workers in the oil world an appropriate memorial to its author. In most chapters there are the results of his characteristically painstaking assembly of data; the constant sense of relativity shown in their summary; the judicial instinct with which conflicting theories are balanced; the conscientious recognition of the work of others; the cautious estimates of "prospects" likely to affect commercial interests; the record of observations privately obtained from innumerable friends; and, finally, the signs of war weariness which probably brought about the fatal illness to which he succumbed only two days after passing for press the complicated section on shale oil and allied industries.

The publication of this edition marks a definite stage in the history of petroleum technology; in complexity its ramifications have now passed beyond the comprehension of any one individual; no single person can hope to prepare the fifth edition of Redwood's "Treatise." Its author has passed away, but his spirit remains incarnated in the Institution of Petroleum Technologists which he founded just before the war, and that body might well regard as its chief mission the maintenance up to date of this its bible as a standard work of reference. The Institution has already in the press a volume summarising recent developments in special branches of the petroleum industry, and this work, supplemented by Mr. Dalton's revised and extended bibliography, will bridge many of the gaps left in the Treatise by Sir Boverton Redwood's unexpectedly sudden death.

T. H. Holland.

Entropy as a Tangible Conception.

Entropy as a Tangible Conception: An Elementary Treatise on the Physical Aspects of Heat, Entropy, and Thermal Inertia for Designers, Students, and Engineers, and particularly for Users of Steam and Steam Charts. By Eng. Lt.-Commr. S. G. Wheeler. Pp. 76. (London: Crosby Lockwood and Son, 1921.) 8*s*. 6*d*. net.

OPINIONS will differ as to the merits of the title which Lt.-Commr. Wheeler has chosen for this volume. The extreme relativist, who regards the notion of force derived from our muscular sensations as a relic of animism, will no doubt condemn it. "To-day we have dispossessed the demons, but the *ghost of a muscular pull* still holds the planets in place."[1] On the other hand, the student of either physics or engineering will welcome any suggestion which assists him in understanding the nature of the "ghostly quantity," entropy. "The more shadowy the conception to be visualised, the greater the need of a definite material analogy." The quotation is from the instructive presidential address to the Physical Society of London delivered by Prof. Callendar in 1911. Here it is pointed out that the caloric theory is perfectly consistent with Carnot's principle and with the mechanical theory for all reversible processes. The quantity measured in an ordinary calorimetric experiment is the motive power or energy of the caloric, and not the caloric itself. Prof. Callendar identifies caloric with the "thermodynamic function" of Rankine, or the "entropy" of Clausius.

With this address and with the important paper by Sir J. Larmor "On the Nature of Heat" (Proc. Roy. Soc. vol. 94, p. 326, 1918) we imagine Lt.-Commr. Wheeler is not acquainted. He sets out to give a more tangible interpretation of entropy than that afforded by Boltzmann's statement that it is "the logarithm of the probability of a complexion." This he endeavours to do, and in our opinion with considerable success, by means of mechanical analogies. There is, needless to say, nothing novel in such an attempt. Poynting and Thomson, in their text-book on "Heat," direct attention to quantities which are analogous to entropy; indeed, we may, according to Prof. Callendar, go back to "the old picturesque phraseology of the material fluid, implied in Carnot's waterfall." Just as gravitational energy may be regarded as the product of mass and the height of the mass above zero level, so heat energy may be regarded as the product of "thermal inertia" and temperature. Thus entropy, being, as Swinburne called it, "the measure of the incurred waste," may be interpreted as "incurred thermal inertia." But in this book a distinct point, which we had not previously met with in print, is made by considering, not linear, but rotational, motion, so that thermal inertia corresponds to the moment of inertia, mk^2, of a rotating system. Here we have a case where the rotational inertia is capable of variation through changes in the value of k, the radius of gyration.

This may be illustrated by suspending a flat, circular disc from a point in its circumference by a thin wire by means of which it can be spun round around a vertical axis (Fig. 1). At first the disc will rotate about its original vertical diameter, but on the attainment of a certain speed the disc will start to

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[1] Dr. Mott-Smith, in J. M. Bird's "Relativity and Gravitation." (Methuen, 1921.)

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